

Application No.: 10/758071

Docket No.: TOW-059

**REMARKS**

Applicants incorporate the limitations of claim 5 into claim 1. Claim 5 is hence canceled. Upon entry of this amendment, claims 1 and 4 are presented for examination, of which claim 1 is independent. Claims 6-9 remain withdrawn. Applicants respectfully submit claims 1 and 4 define over the art of record.

**Claim Rejection**

Claims 1, 4, and 5 are rejected under 35 U.S.C. §103(a) as being unpatentable over United States Patent No 6,257,479 to Litwinski et al. (hereafter "Litwinski"). Applicants respectfully submit that the Litwinski reference does not teach or suggest a backing jig having an outer circumferential surface of *a completely circular shape*, as required by amended claim 1. The Litwinski reference also does not teach or suggest the step of separating the backing jig from the abutment portion after friction stir welding by *relatively thermally expanding* the first and second cylindrical members as compared with the backing jig, as required by claim 1.

**The Claimed Invention**

The claimed invention uses a backing jig having an outer circumferential surface of a completely circular shape so that the first cylindrical member and the second cylindrical member can be reliably secured to the backing jig. The shape of abutment portion between the first and second cylindrical members can also be maintained circular, especially when they are made of thin metal and have a large diameter. The claimed invention hence solves the problem of deformation or irregularity in the shape of the abutment portion when two cylindrical members are joined together using friction stir welding.

The claimed invention uses a friction stir welding method that thermally expanded the first and second cylindrical members to fit them onto the backing jig so that the entire inner surface of the abutment portion is in close contact with the entire outer surface of the backing jig. After the friction stir welding process, the backing jig is separated from the first and second cylindrical members by *relatively thermally expanding* the first and second cylindrical members as compared with the backing jig.

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The Litwinski Reference

The Litwinski reference teaches a back-up tooling apparatus including multiple shoes and a radially expandable support. The expandable support has multiple arms attached to the multiple shoes so that the shoes can be extended outward to reach the inner surface of a workpiece thus holding the workpiece in place. In other words, the back-up tooling apparatus is first inserted in the hollow space of the workpiece and the expandable support expands the shoes towards the workpiece so that the shoes form a support for the workpiece. To take the back-up tooling apparatus out of the workpiece, the shoes are retraced inwardly as the expandable support is *mechanically* retracted.

In contrast, the claimed invention requires that the backing jig to be removed by relatively thermally expanding the first and second cylindrical members as compared with the backing jig. Although the Examiner asserts that the back-up tooling apparatus is configured to counteract thermal expansion the workpiece undergoes under friction stir welding operation so that the workpieces do not expand and lift away from the shoes, the Litwinski reference fails to teach or suggest that the back-up tooling apparatus can be removed by thermally expanding the workpiece. Hence, Applicants respectfully submit that the Litwinski reference does not teach or suggest the step of separating the backing jig from the abutment portion after friction stir welding by *relatively thermally expanding* the first and second cylindrical members as compared with said backing jig, as required by claim 1.

Additionally, claim 1 further requires that a backing jig having an outer circumferential surface of a *completely circular shape*. Hence, the roundness of the entire circumference of the abutment portion is maintained and the dimensional accuracy is effectively improved. In contrast, the Litwinski reference teaches that the shoes can form a substantially continuous ring to support the workpiece with a step in between two adjacent shoes. Hence, the back-up tooling apparatus taught by the Litwinski reference cannot form a completely circular shape, but rather forms an approximate circular shape.

Furthermore, the Litwinski reference requires the ring formed by the shoes is slightly larger in diameter than the relaxed inner diameter of the workpiece in order to counteract

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thermal expansion of the workpiece as a result of frictional heating during a welding operation, so that the workpiece does not lift away from the shoes, even when the workpiece is expanded.

In contrast, the claimed invention has an advantageous feature to have the single backing jig to closely fit with the first and second cylindrical members on the entire circumferential surface of the single backing jig without mechanical expansion and contraction. The teachings of the Litwinski reference do not provide this advantageous feature. In fact, the Litwinski teaches away from the claimed invention because the Litwinski reference considers a one-piece or fixed geometry back-up tool is impractical and that the back-up tool must be constructed from a plurality of members. See Col. 1, lines 47-54.

Accordingly, Applicants respectfully submit that the Litwinski reference also does not teach or suggest that the backing jig having an outer circumferential surface of a completely circular shape, as required by amended claim 1. Applicants respectfully request that the Examiner reconsider and withdraw the rejection of claim 1.

Applicants note that the dependent claims also recite patentable subject matter. As such, for this and the reasons set forth above, Applicants respectfully submit that the dependent claims also define over the art of record.

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**CONCLUSION**

In view of the above amendment, Applicants believe the pending application is in condition for allowance.

Applicants believe no fee is due with this statement. However, if a fee is due, please charge our Deposit Account No. 12-0080, under Order No. TOW-059 from which the undersigned is authorized to draw.

Dated: May 22, 2006

Respectfully submitted,

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